

An Overview of the INTEX-A/ICARTT Experiment

H. Singh, & Science Team

GOAL: To understand the transport, transformation, & impacts of gases & aerosols on air quality & climate on intercontinental scales

- INTEX-A: Summer 2004
 - large biosphere emissions
 - active photochemistry
 - max terrestrial carbon uptake
- INTEX-B: Spring 2006
 - maximum Asian inflow to NA
 - seasonal contrast

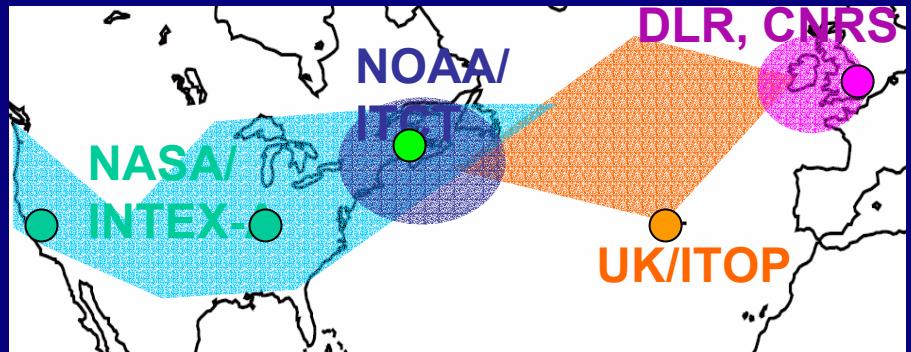
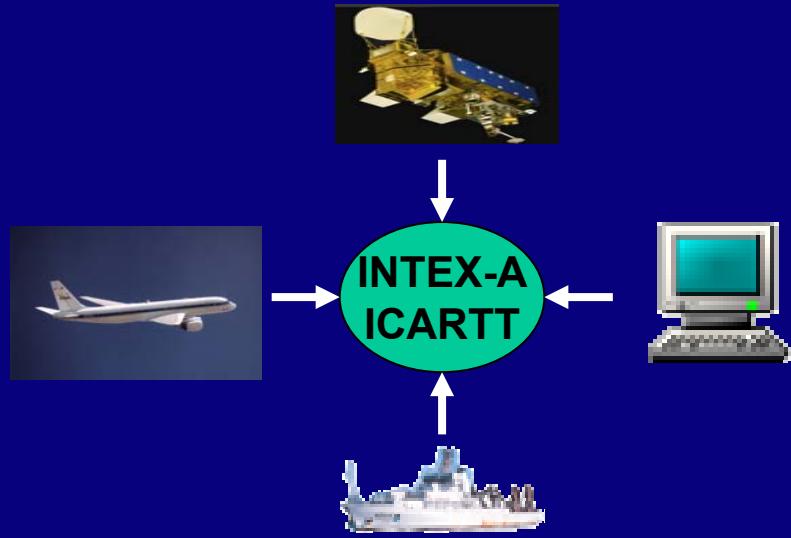


Intercontinental Chemical Transport Experiment North America
International Consortium for Atmospheric Research on Transport and Transformation

INTEX-A - Science Objectives

- Quantify North American outflow of environmentally important gases/aerosols & relate to sources & sinks
- Characterize & understand transatlantic transport of North American pollution & its chemical evolution
- Characterize sources of pollution over NA
- Characterize direct/indirect effects of aerosols over northeastern NA & western North Atlantic
- Validate satellite observations of tropospheric composition & relate to airborne & surface data

INTEX-A/ICARTT Plan & Coordination

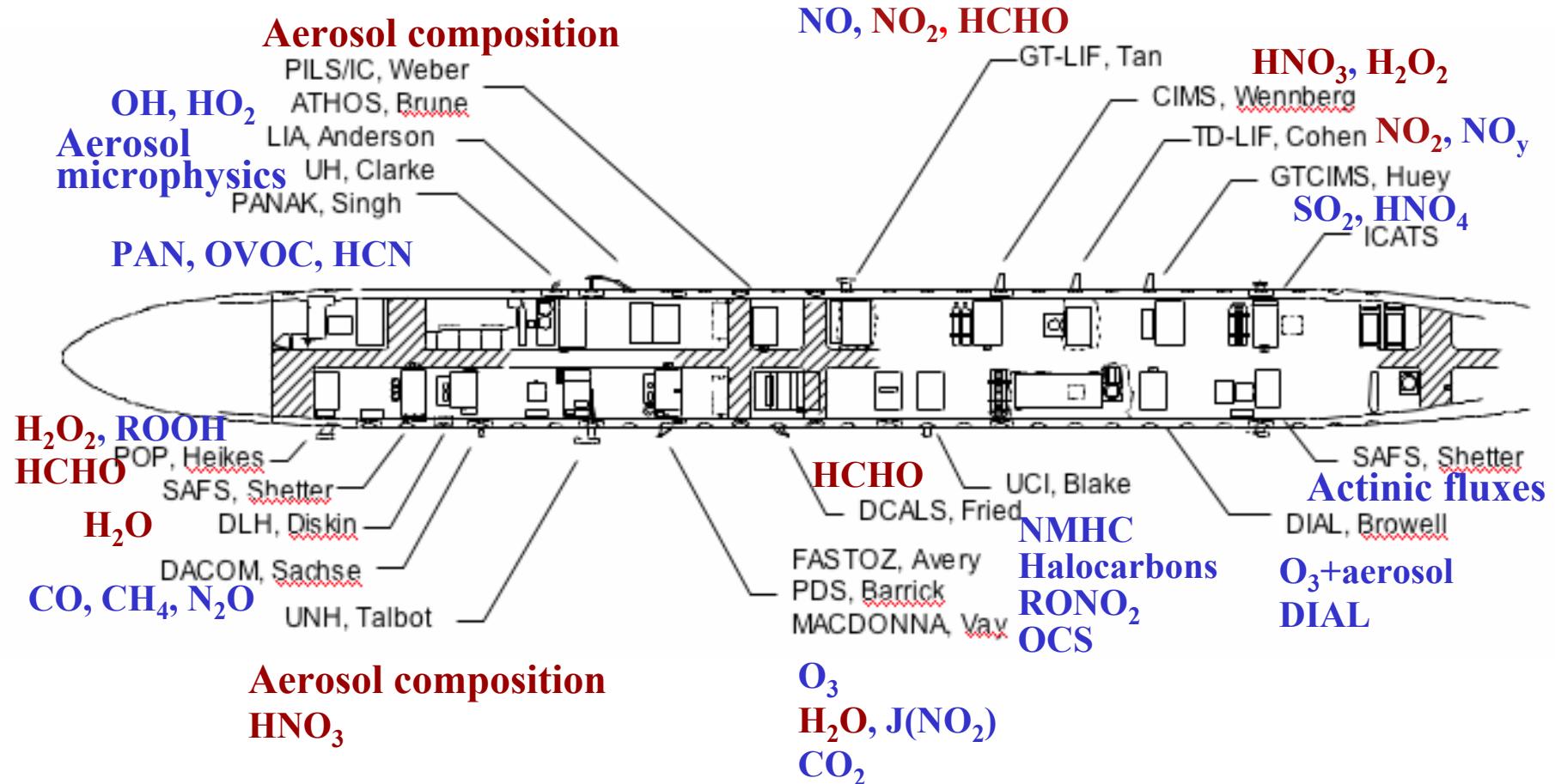


US, Canada, UK, France, Germany

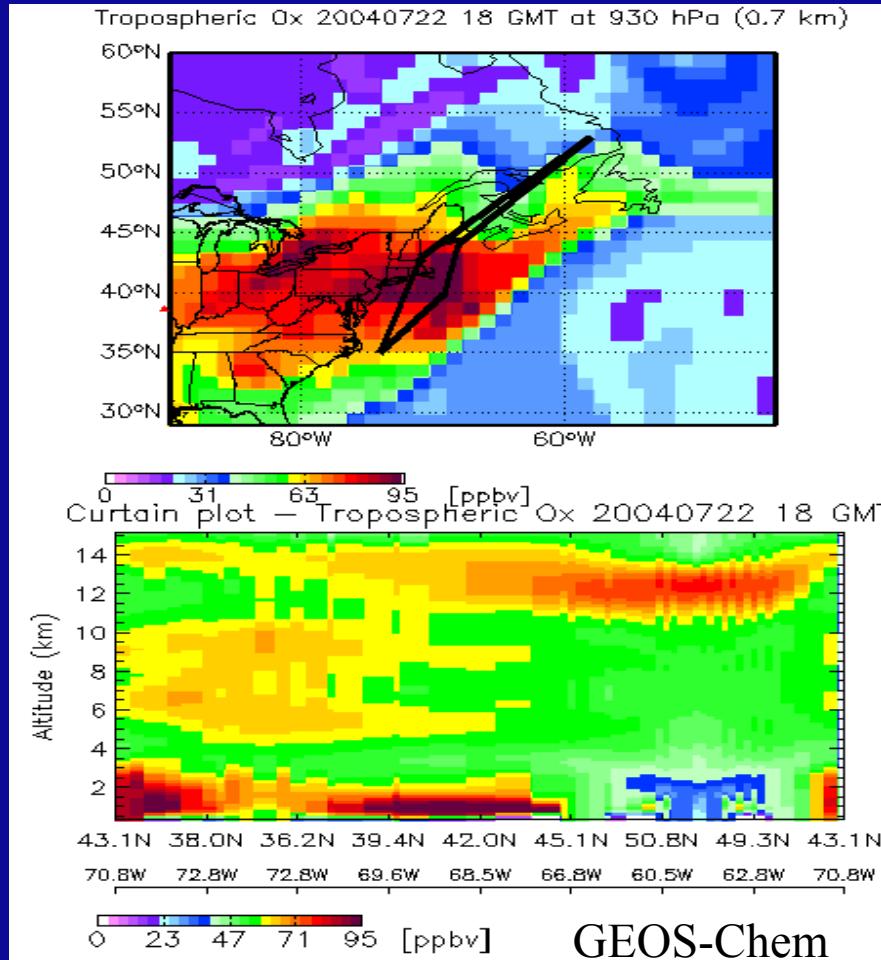
- Outflow of gases/aerosols
- Source characterization
- Chemical evolution
- Carbon cycle
- Direct/indirect effects of aerosols
- Satellite validation

- Inter-comparisons
- Coordinated Science flights
- Sharing of forecasts & data
- Joint publications

DC-8 Payload



Forecast Products



MET data/Trajectories
(FSU)

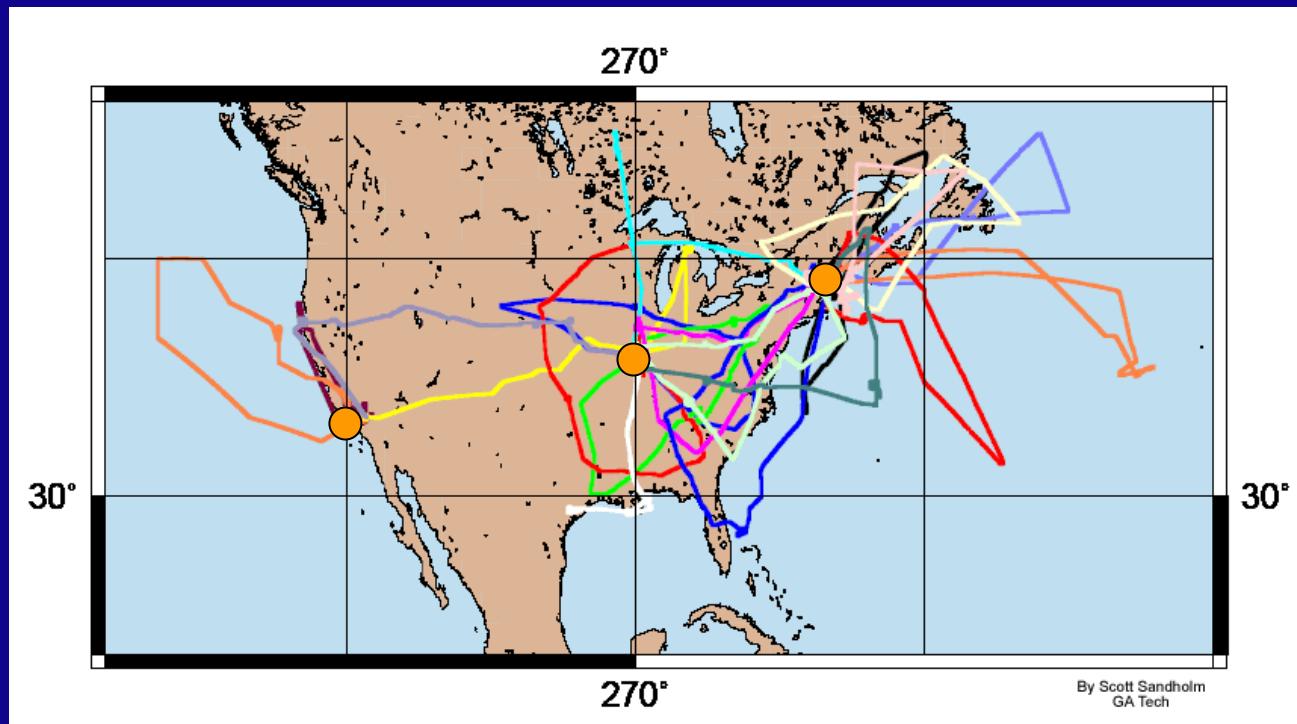
Convective influences
(GSFC/ARC)

AIRS CO (UMD)
MOPITT CO (NCAR)
MODIS Aerosol
(UMD/Langley)

GEOS-Chem (Harvard)
MOZART (NCAR)
RAQMS (Langley)
STEM/CFORS (U. Iowa)

INTEX-A DC-8 Flight Tracks

(Missions 2-20; June 29 - August 14, 2004)



170 DC-8
flight hrs
(20 flights)

EAB- 2 T
EAB- 1 S
MA- 4 S
P- 9 S
TR- 4 S

DC-8 Coordinated Activities

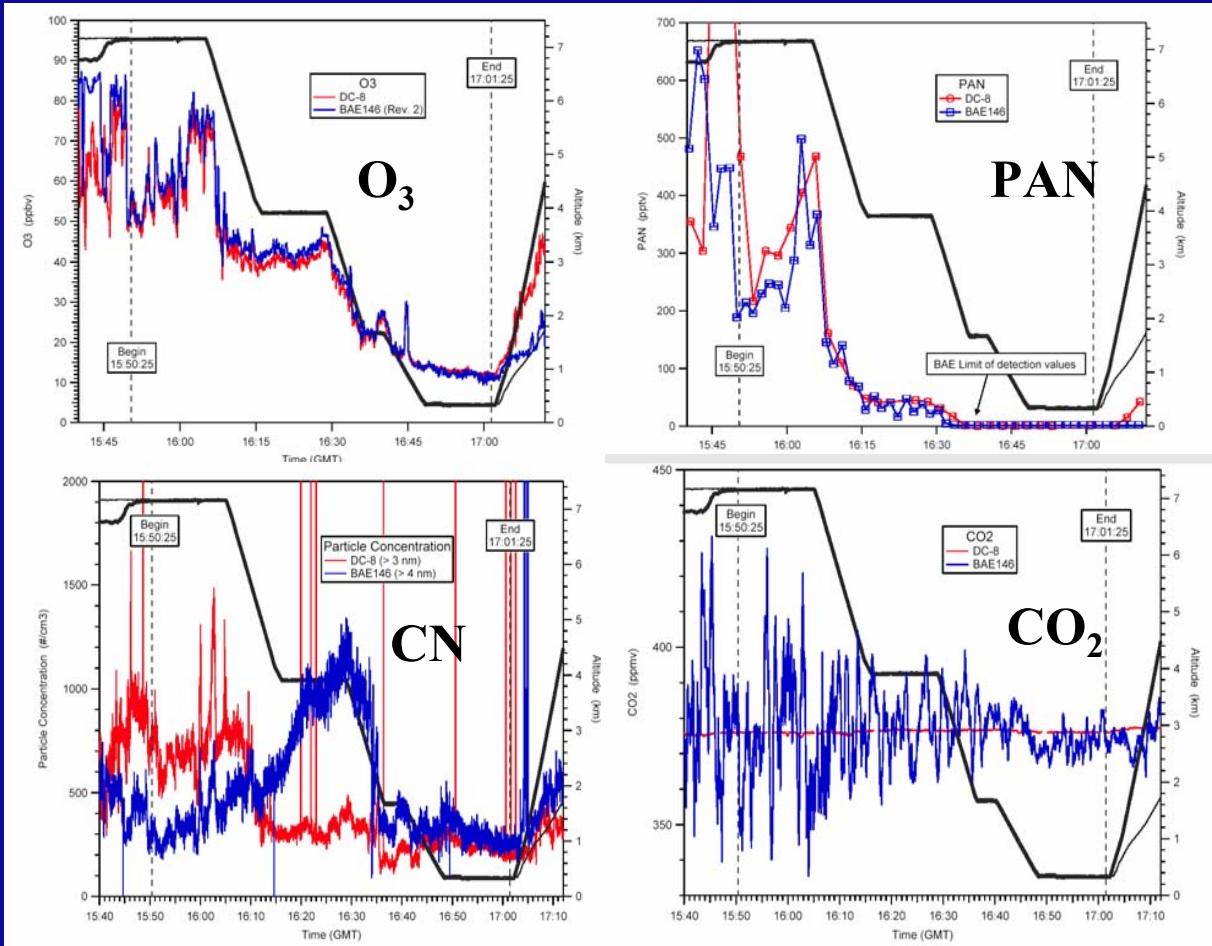
Flight No.	2004 Date	Base	DC-8	Terra	Aqua	Envista	P-3	J-31	BAe-146	King Air	Other*
3	7/1	Dryden	X		X						
4	7/6	Transit	X								
5	7/8	MidAmerica	X	X							
6	7/10	MidAmerica	X		X	X					
7	7/12	MidAmerica	X		X	X					
8	7/15	Transit	X	X	X					X	
9	7/18	Pease	X		X	X					X
10	7/20	Pease	X		X			X			
11	7/22	Pease	X	X			X	X			X
12	7/25	Pease	X	X	X						
13	7/28	Pease	X						X		
14	7/31	Pease	X	X	X	X	X				
15	8/2	Pease	X	X	X			X			X
16	8/6	Pease	X	X							X
17	8/7	Pease	X	X			X	X			X
18	8/11	Transit	X	X	X						
19	8/13	MidAmerica	X	X	X						
20	8/14	Dryden	X		X						

* Ron Brown, Aeronet, Lidars, ground stations, Proteus

Targeted INTEX-A Science Objectives

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Large-scale characterization of the troposphere across N. America	X	X	X	X	X		X			X	X	X	X	X	X	X		
Characterization of continental boundary layer chemistry and venting		X	X	X		X	X			X			X	X		X	X	
Large-scale continental outflow characterization						X		X		X			X	X	X	X	X	X
Chemical aging over the N. Atlantic												X	X					
Convective venting to the upper troposphere	X	X	X	X						X				X				
Transpacific transport of Asian pollution plumes	X					X		X						X				X
Intercomparison with other platforms						X		X	X		X	X	X		X			
Satellite validation	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Quasi-Lagrangian Sampling (IGAC)						X	X	X	X	X	X	X						

DC-8 Intercomparisons

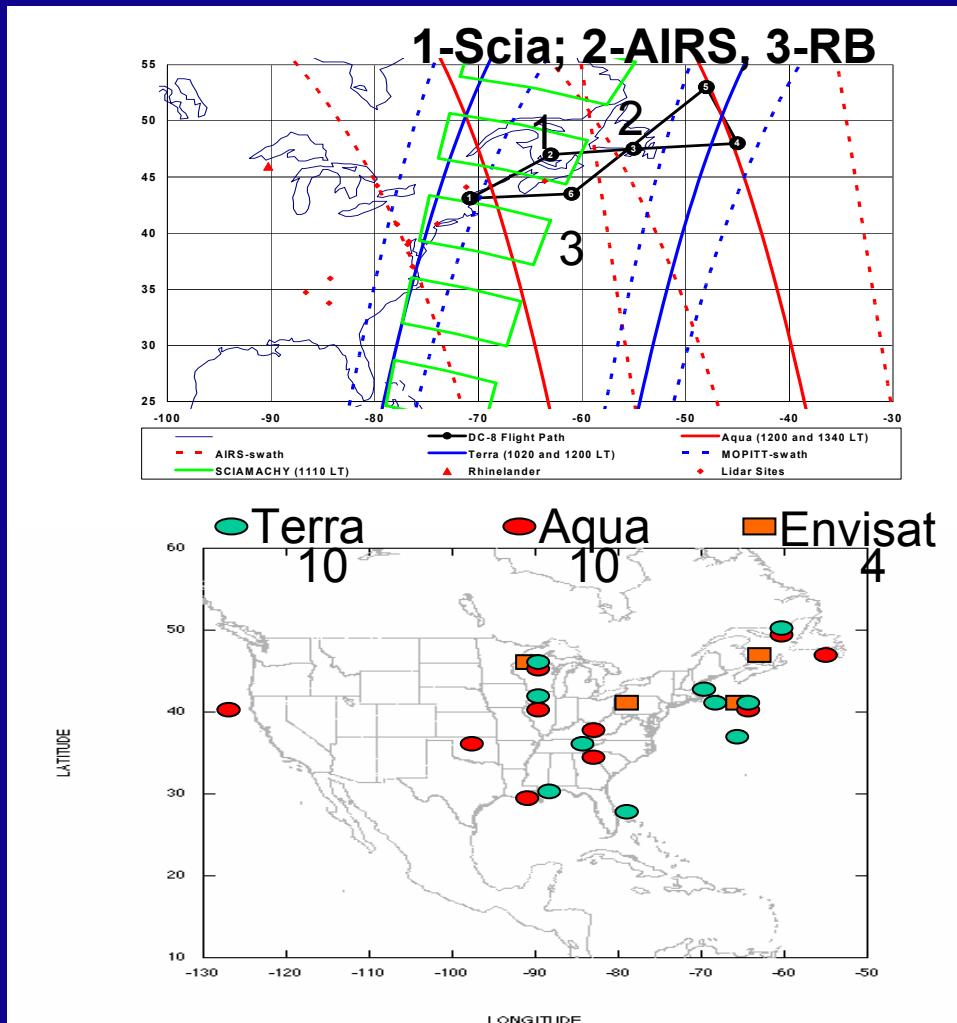


- 3 P-3
- 1 BAe146
- Ship
- Surface sites

INTEX-A DC-8 Satellite Validations

(Terra, Aqua, Envisat)

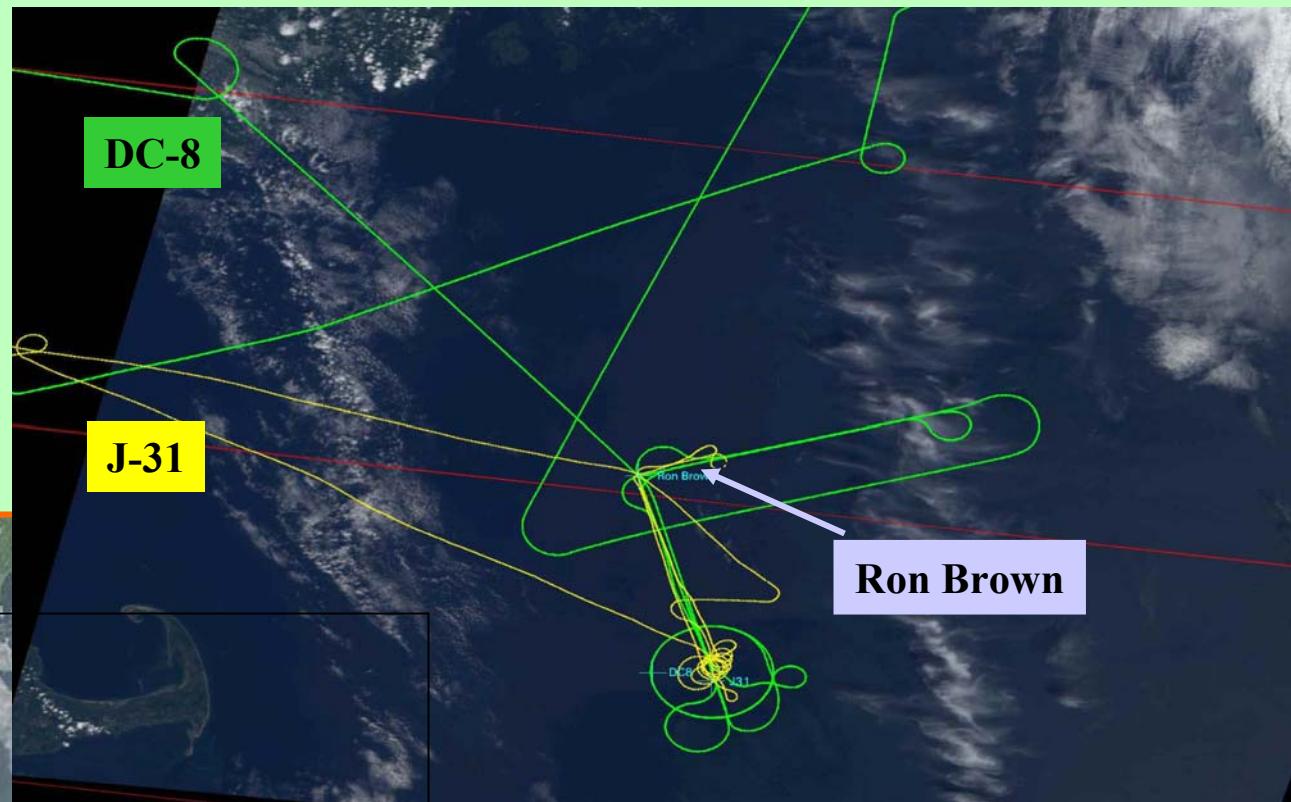
CO
HCHO
NO₂
SO₂
H₂O
HCN
O₃
Aerosol
Organics



- **DC-8/J-31/RB:**
 - MOPITT
 - MISR
 - AIRS
 - SCIAMACHY
- Profiles:
 - to 11 km
 - cloud free
 - 15 mi spiral
 - 1 hr window

INTEX-A MISR Stacked L's Maneuver in Co-ordination with NASA DC-8, J31 and Ron Brown (08/07/2004)

MISR Image with flight track L's Superimposed over Ron Brown Location

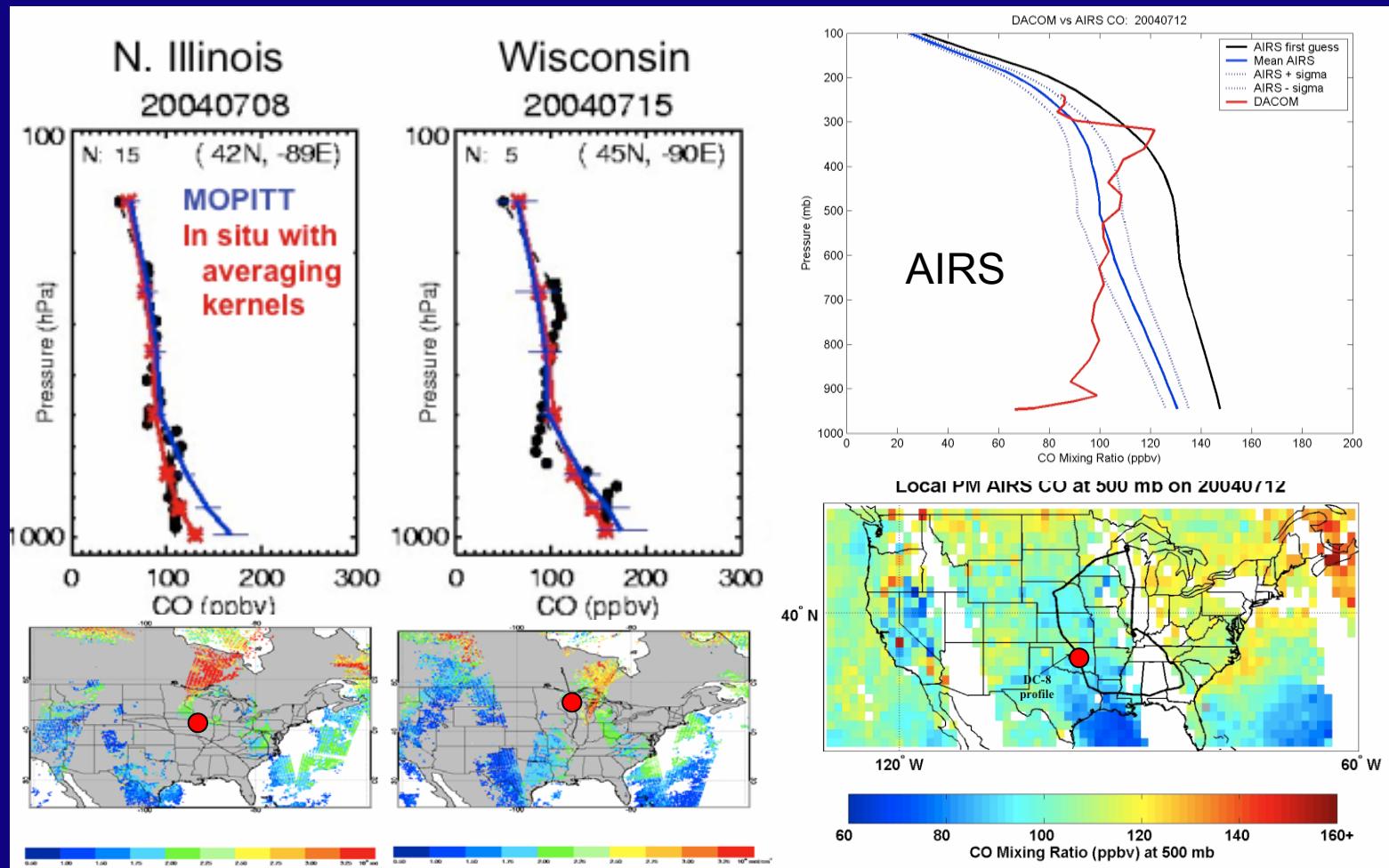


Imaged Region

- Aerosol variability along- & across-wind directions.
- Closure tests with *in-situ* aerosol observations

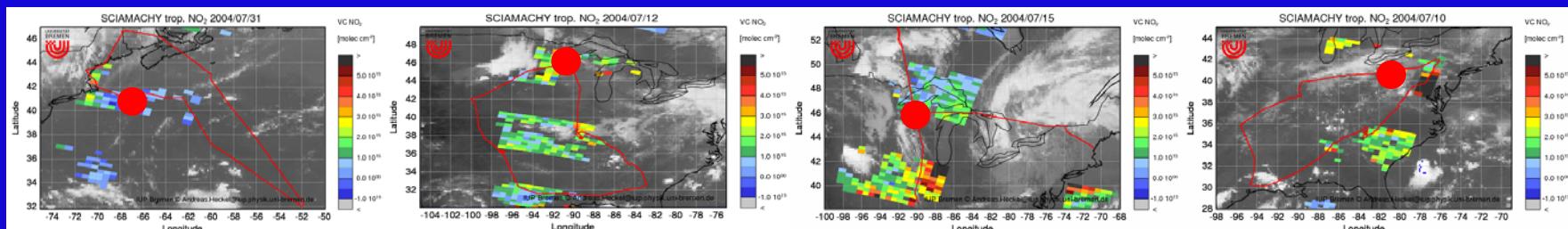
R. Kahn/ A. Clarke/ P. Russell/T. Bates et al

DC-8/MOPITT, AIRS Trop CO



DC-8/SCIAMACHY Trop Column NO₂

	Atlantic	Rhinelander I	Rhinelander II	Pittsburgh	
DC8	$6.2 \cdot 10^{14}$	$8.3 \cdot 10^{14}$	$5.6 \cdot 10^{14}$	$2.4 \cdot 10^{15}$	molec/cm ²
SCIA	$7.0 \cdot 10^{14}$	$1.8 \cdot 10^{15}$	$1.0 \cdot 10^{15}$	$3.1 \cdot 10^{15}$	molec/cm ²



7/31

7/12

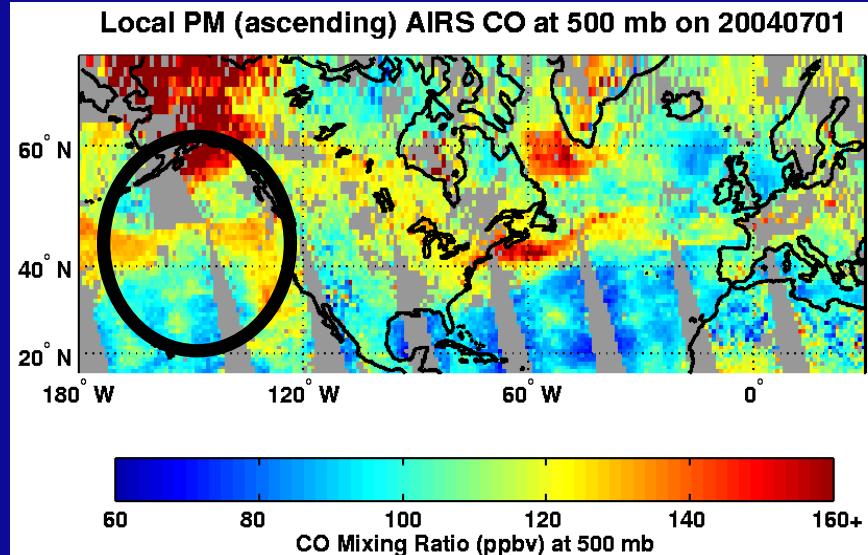
7/15

7/10

- Stratospheric correction
- Climatological airmass factors from MOZART
- Cloud screening but no cloud correction

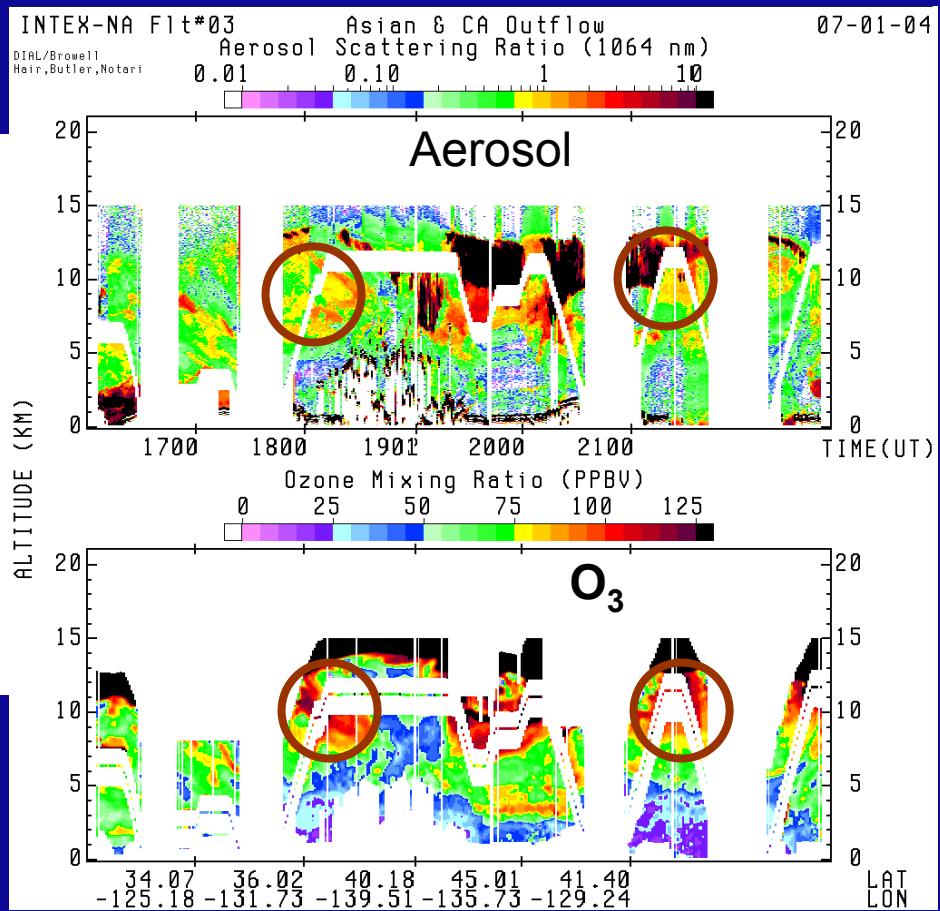
Heckel, Richter, Burrows, Cohen

Asian Outflow Seen by AIRS & Sampled by the DC-8



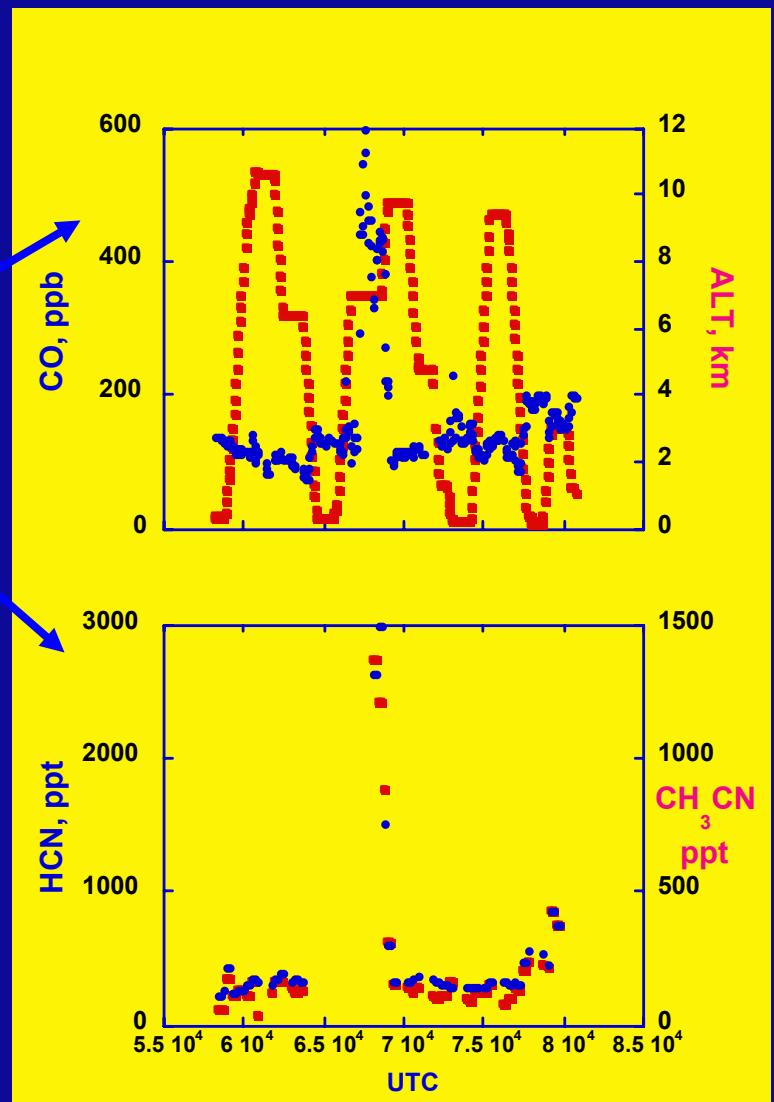
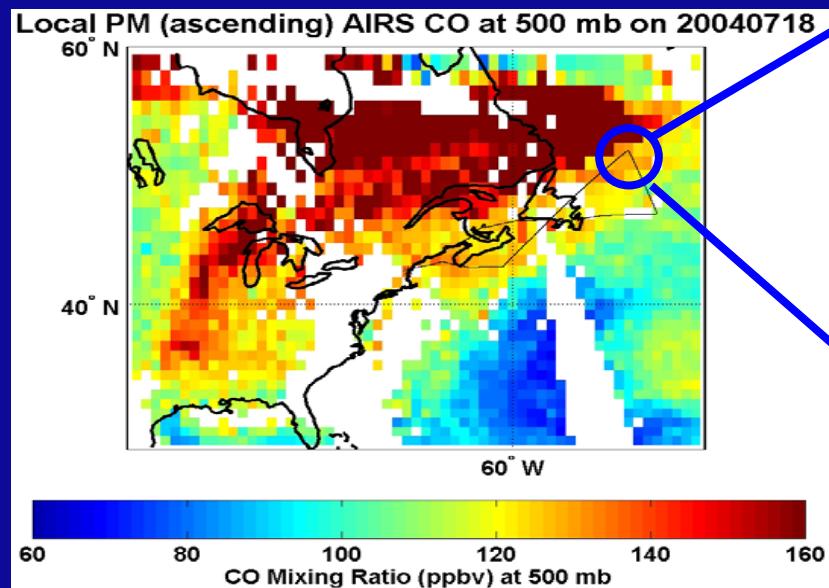
July 01, 2004

McMillan

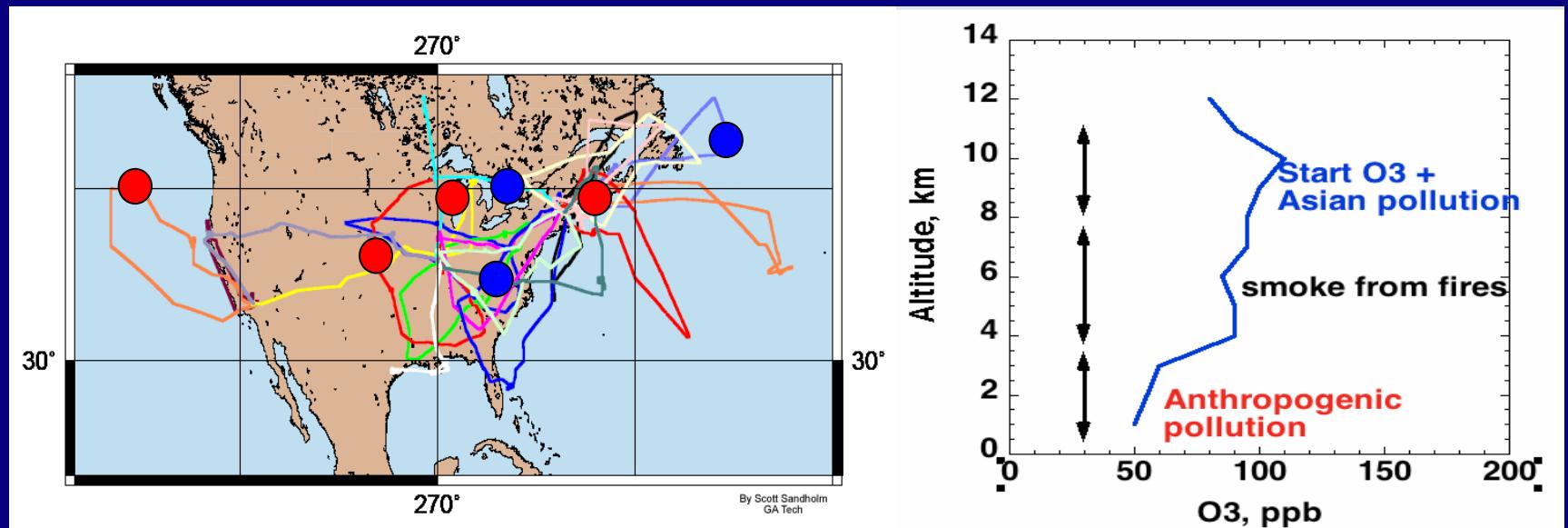


Browell

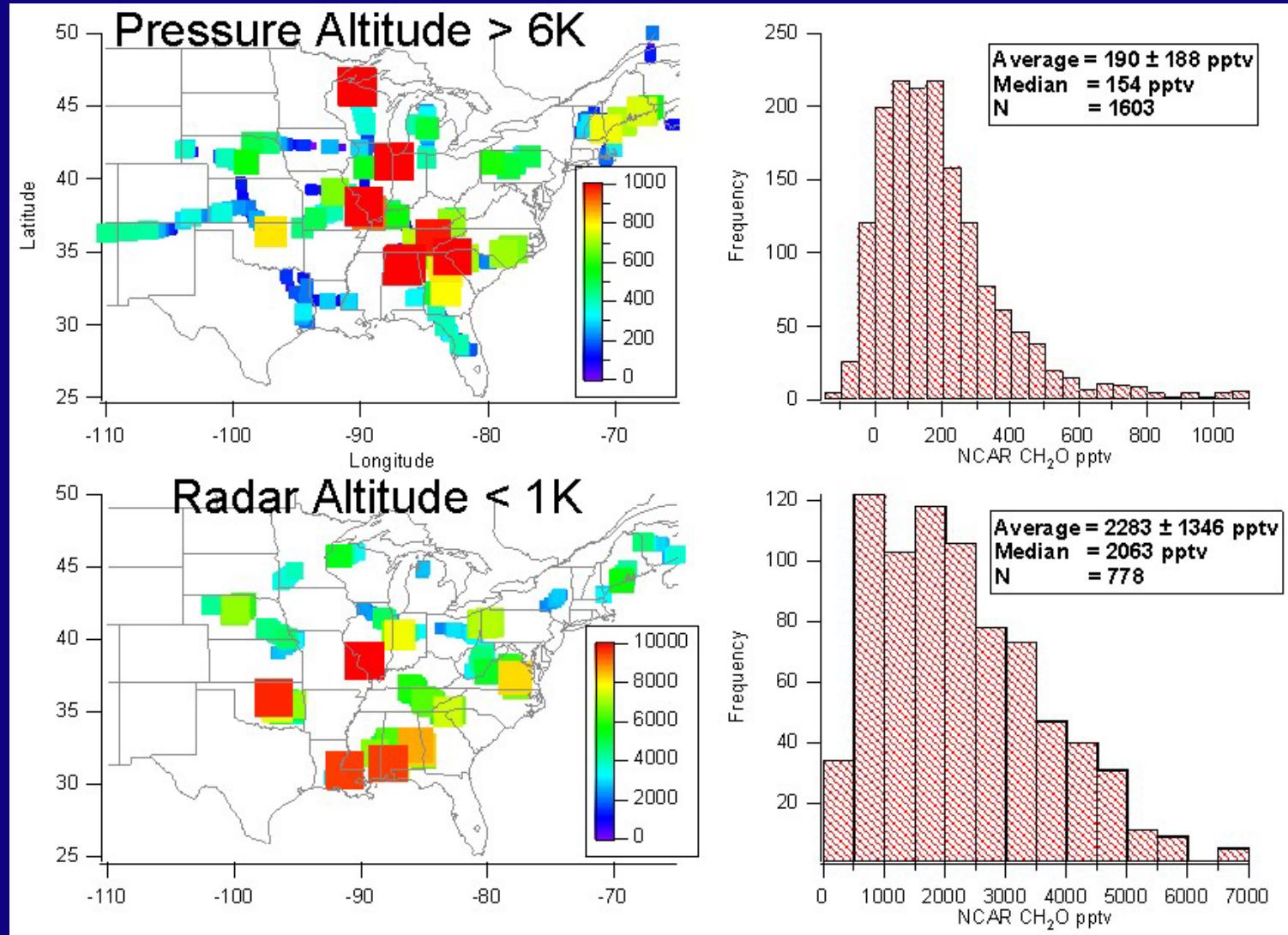
Alaskan Fire Influences Over the Atlantic



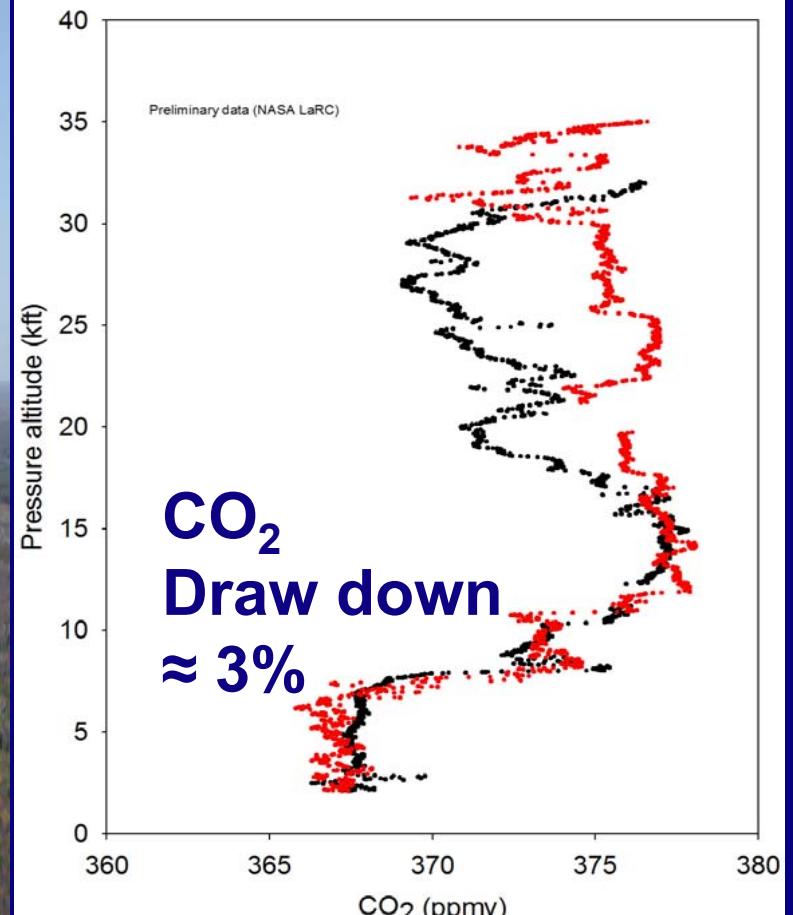
Asian Influences, Fires, & Vertical Structure



CH₂O Distributions & Convection

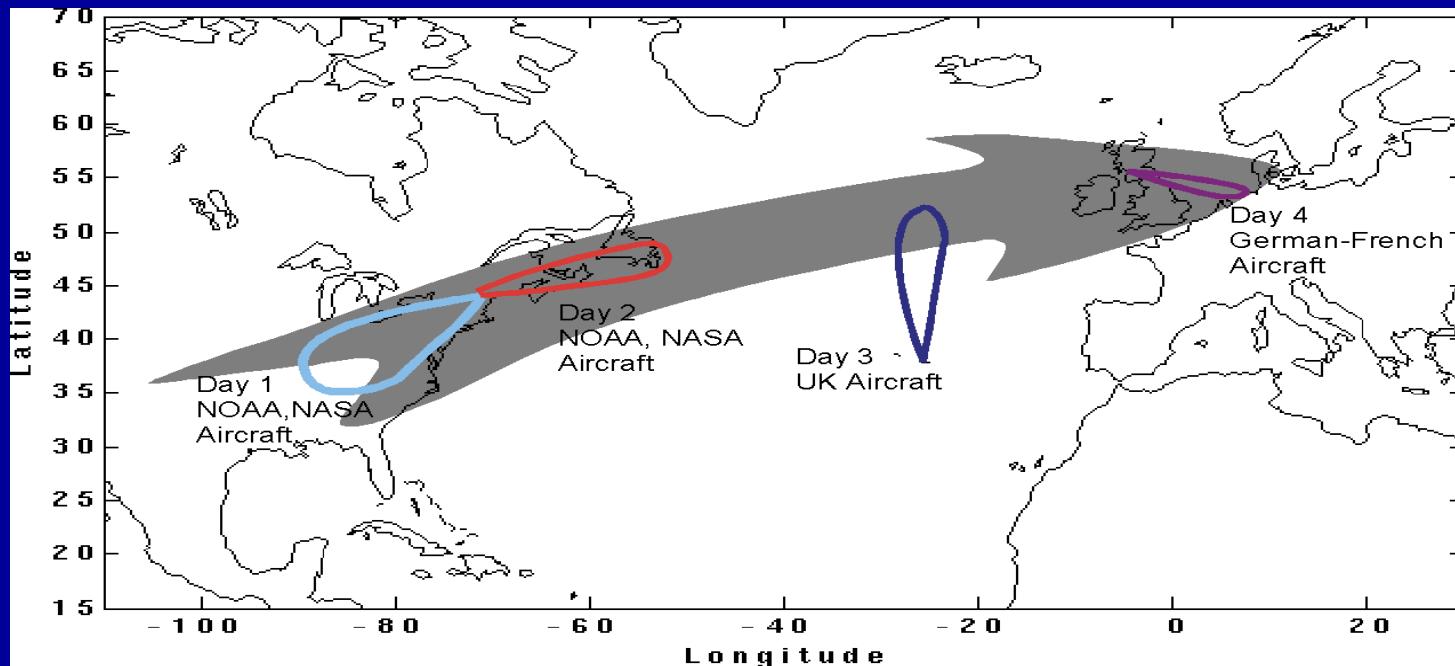


Carbon Cycle in INTEX-A



Quasi-Lagrangian Experiments Over the Atlantic

A central goal of US-EU coordination



- 7 potentially successful cases identified
- Best matches on 4 (7/18, 7/20, 7/25, 7/28)

Some Questions?

- How do the in-situ measurements from different instruments & platforms intercompare? How do we synthesize and relate data from multiple platforms?
- How do models in forecast and analysis modes intercompare with each other and with observations?
- How useful were the satellite validation flights? Have we contributed to further improvements in retrievals?
- How usefully can the satellite data be integrated with the aircraft & surface data to extend coverage?
- Can we uniquely identify Asian influences?
- How successful were the quasi-lagrangian experiments and what did we learn from them?

Some Questions? (cont.)

- Can we use INTEX-A data (& models) to further constrain estimates of anthropogenic & biogenic emissions particularly for VOC, OVOC, SO₂, CO, NO_x, & aerosols?
- What do Alaskan fires tell us about dynamical processes and can we infer BB burning emissions from INTEX-A observations?
- What are the factors controlling the outflow of pollution (especially NO_x, O₃, and aerosol) to the Atlantic?
- What are the sources and properties of aerosols & how do they evolve over the Atlantic? Is SO₂ the main precursor? Is there direct evidence for the predicted Saharan dust?
- What have we learnt about direct and indirect effects of aerosol on radiative forcing?

Some Questions? (cont.)

- Are the observed HO_x and precursor (peroxides and CH₂O) concentrations consistent with current understanding?
- How does deep convection affect the supply of HO_x and NO_x to the upper troposphere? What is the effect of carbonyls on the HO_x and NO_x budgets?
- Is there evidence for OVOC loss by heterogeneous processes?
- Can we explain the observed drawdown of CO₂ over the continent?
- Are the new observations of HNO₄ consistent with our present understanding?

INTEX-A Team

INTEX Science Team

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NASA HQ

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W. McMillan, UMBC
B. Pierce, LaRC
A. Thompson, GSFC/ARC

Project manager
M. Craib
M. Gaur
K. Shiff

- Mission managers
(Curry/Miller/Jennison)
- Navigators
- Pilots
- Crew

ICARTT Summer 2004 - Flight tracks of major aircraft

